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MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS, BAYOU DORCHEAT RESERVOIR, ARKANSAS

Public Health Service
Dallas, Texas

October 1960

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MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS

BAYOU DORCHEAT RESERVOIR

ARKANSAS

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DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VII
Dallas, Texas

In Cooperation with the

DEPARTMENT OF THE ARMY
U. S. Army Engineer District - New Orleans, Louisiana

OCTOBER 1960

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BAYOU DORCHEAT RESERVOIR

ARKANSAS

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VII
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INTRODUCTION

Authority

In a letter dated February 11, 1959, the District Engineer, U. S. Army Engineer District, New Orleans, requested the Public Health Service to prepare a preliminary evaluation of the need for water supply storage and its value (benefits) for the following streams:

1. Cypress Creek above Ferrells Bridge Reservoir.
2. White Oak Creek.
3. Little Cypress Creek.
4. Bayou Dorcheat.
5. Black and Cypress Creeks.
6. Bayou Bodcau.

Bayou Dorcheat is considered in this report. The others are taken up in separate reports.

Purpose and Scope

This report presents the pertinent information and data relating to the determination of future water requirements for municipal and industrial purposes in the Bayou Dorcheat Basin, and how these requirements may be met. Consideration is given to water supply storage at either of two sites within the basin, together with the effects of existing and future pollution.

The evaluation of water needs encompasses locale, natural resources, economy, growth prospects, projections of municipal and industrial water use and waste production to the year 2010.

Acknowledgments

Acknowledgment is gratefully made for the assistance of the Arkansas Water Pollution Control Commission; Louisiana Stream Control Commission; the State Health Departments of both Louisiana and Arkansas; and Chambers of Commerce and city officials in Minden and Springhill, Louisiana, and Magnolia, Arkansas.

SUMMARY AND CONCLUSIONS

Summary

1. Two reservoir sites are available in the Bayou Dorcheat Basin which could include storage for municipal and industrial water. One of these locations, referred to as site 14, is situated on Big Creek near its junction with Bayou Dorcheat (mile 101.6), while the other site (20) is on Bayou Dorcheat at mile 103, just upstream from Big Creek.

2. The sites are located adjacent to one another so that either could serve essentially the same area in northwestern Louisiana and southwestern Arkansas. This area contains three major population centers: Minden and Springhill, Louisiana, and Magnolia, Arkansas. There are also 16 smaller communities.

3. Except for the paper mill at Springhill, the municipal and industrial water supply needs in this area are being met by ground water from the Sparta sand, which underlies the region. The mill recently began taking its water from an impoundment in the Bodcau Basin. (Present use - 30 mgd).

Conclusions

1. It is expected that the Sparta sand will meet the water supply requirements of the study area projected to the year 2010 with but one exception, the Magnolia, Arkansas, area.

2. There is no demand for storage for municipal and industrial water supply purposes in the proposed project now or within the 50-year period of analysis. The Magnolia, Arkansas, area may require 3.5 mgd toward the end of the period if its present sources in the Sparta sand do not prove adequate. However, Magnolia can develop a satisfactory source of supply on nearby Big Creek for less than the transmission cost from the proposed project. It is therefore more feasible for this area to construct a single-purpose reservoir on Big Creek than to rely on the proposed project on Bayou Dorcheat. (Site 14 is not considered for reasons stated below.) Hence, no value can be attributed to storage for municipal and industrial water supply purposes in the proposed project.

3. The quality of the water at proposed site 20 does not consistently meet the recommended Public Health Service standards of quality with respect to chloride content. This degradation of quality is caused by oil-field brine discharges. The pollution control agency of Arkansas is embarked on a program to abate this pollution by 1964. This project site could be studied again after the brine clean-up to ascertain its usefulness for municipal and industrial water supply storage. Louisiana's pollution control agency is moving toward the same objective on the lower reaches of the stream.

4. The placing of an impoundment on Big Creek, at proposed site 14, will impair the waste assimilating capability of the stream. This site is situated downstream from the treated wastes released in the Magnolia area. Assuming that treatment will be provided to remove 90 per cent of the biochemical oxygen demand (BOD) of all wastes prior to discharge, the residual wastes (in projected quantities) could still produce periodic nuisance conditions in an impoundment at this site. This detracts from its usefulness for water supply storage or other purposes. Site 20 is more desirable.

DESCRIPTION OF PROJECT SITES

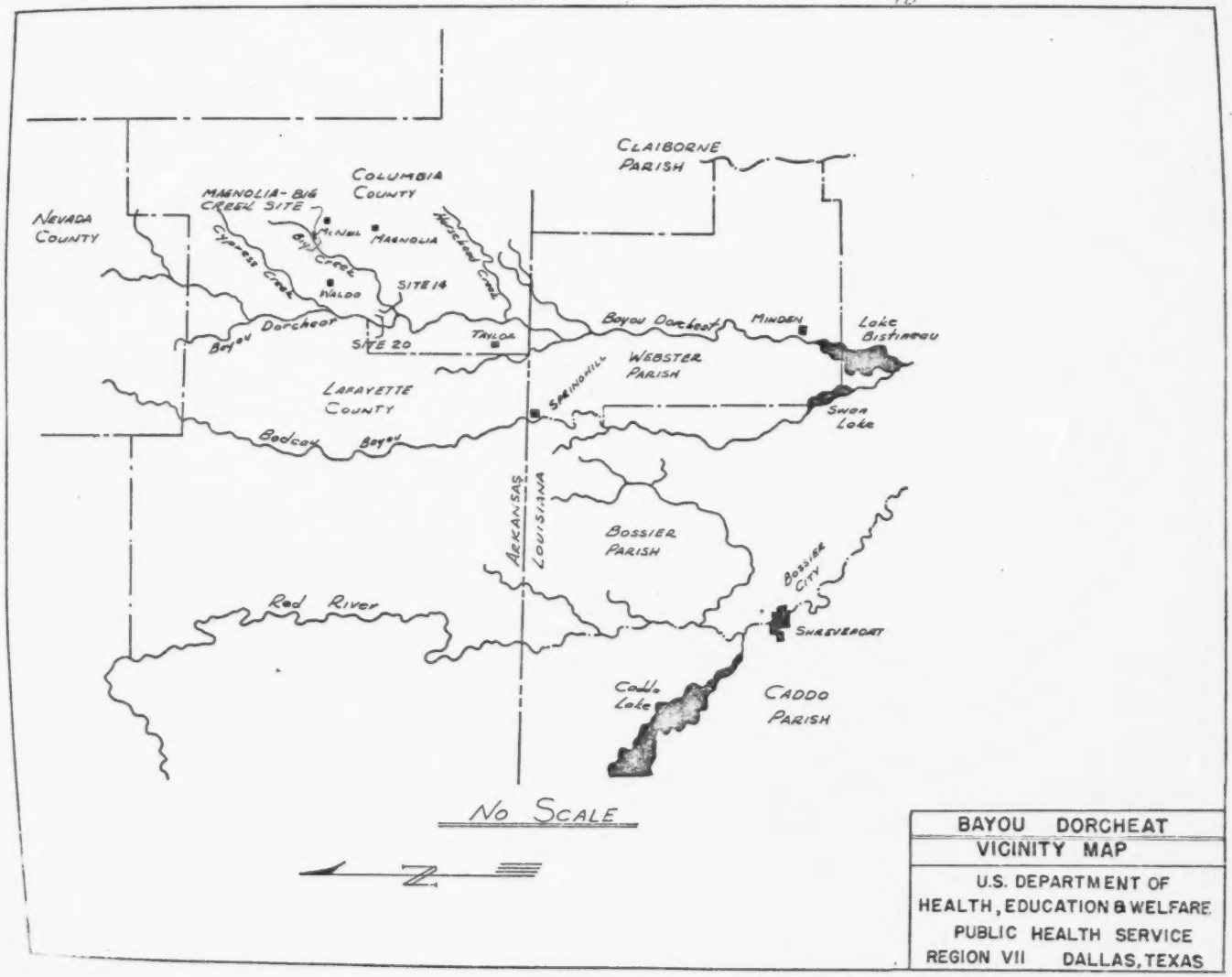
Bayou Dorcheat rises in southern Nevada County, Arkansas, about 10 miles north of the Nevada-Columbia County line. See Figure 1. It is approximately 120 miles long and flows in a general southerly direction through Arkansas and Louisiana, to enter Red River through Lake Bistineau. The drainage area is approximately 1,400 square miles and of that nearly 500 is in Arkansas. The upper end of the drainage basin is about 300 feet above sea level, while the lower end is approximately 150 feet above sea level.1,2/

Throughout its entire length the stream runs through rolling, hilly country. From mile 25 to the head, the valley averages 1-1/4 miles in width. Low-water and high-water slopes average 1 to 1-1/2 feet per mile. The channel dimensions from the headwaters to mile 100 range from a trace to an average top width of 175 feet and a bank height of 15 feet. Below mile 100 to the mouth the average dimension remains constant, being 175 feet in width, with 15-foot banks, except for Lake Bistineau at the lower end.1/

Stage and discharge information is obtained from a gaging station located at Minden, Louisiana, mile 40. This station is maintained by the U. S. Geological Survey. There also are a number of rainfall stations within or near the drainage area. The average rainfall of 56.3 inches is distributed throughout the year, with the greatest concentration coming in late winter and early spring.1/ Flow at the Minden station averages 1,241 cfs, ranging between zero and 40,000 cfs.

Over the years, the chloride and hardness content of the stream has gradually increased. During December, 1959, both of these chemical characteristics reached a maximum concentration--797 ppm chlorides and 328.4 ppm hardness at the Minden gaging station. These constituents are the result of natural conditions on the watershed, i.e., the presence of salt and sulfate in the soil. However, the increase in concentration to the current level is the consequence of oil-field brine being released to the stream and its tributaries in the upper reaches. Arkansas' and Louisiana's pollution control agencies are presently carrying on clean-up campaigns to remove these brine discharges from the streams.

Of several projects being evaluated in Bayou Dorcheat Basin, there are two sites under consideration - site 20 and site 14 - which can include storage of water for municipal and industrial purposes.



BAYOU DORCHEAT VICINITY MAP
U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE PUBLIC HEALTH SERVICE REGION VII DALLAS, TEXAS

FIGURE 1

Site 14

Proposed dam site 14 is on Big Creek just above its confluence with the main Bayou Dorcheat at mile 101.6. This is in Columbia County, Arkansas, approximately nine miles downstream from Magnolia, Arkansas, (see Figure 1). Pertinent data relating to site 14 (and site 20) are compiled in Table 1.

Site 20

Site 20, as proposed, is situated on Bayou Dorcheat at about mile 103, just upstream from the mouth of Big Creek. At this point, Bayou Dorcheat forms the boundary between Lafayette and Columbia Counties, Arkansas, (see Figure 1). Table 1 lists pertinent data relating to site 20.

Table 1[3/]

Pertinent Data on Reservoirs

	Conservation or Minimum Pool	Water Supply Pool	Flood Control Pool
Reservoir Site 14			
Drainage Area (sq.mi.)	---	---	136
Top of Pool (ft., msl)	219	229	248
Area (acres)	300	1,600	7,700
Water Storage (acre-feet)	1,000	10,000	85,000
Silt Storage (acre-feet)	---	1,000	2,000
Valley Elevation (ft., msl)	---	---	213
Firm Yield, cfs	---	12	---
Reservoir Site 20			
Drainage Area (sq.mi.)	---	---	239
Top of Pool (ft., msl)	218	225	250
Area (acres)	600	2,400	17,400
Water Storage (acre-feet)	1,000	10,000	209,000
Silt Storage (acre-feet)	---	1,000	2,000
Valley Elevation (ft., msl)	---	---	215
Firm Yield, cfs	---	10	---

GENERAL DESCRIPTION OF STUDY AREA[4/]

The study area comprises Claiborne and Webster Parishes in northwestern Louisiana, together with Columbia, Nevada, and Lafayette Counties in southwestern Arkansas. This is a region of low, wooded hills. The climate affords a long growing season and the soil is conducive to the growth of a variety of crops. However, a great many of the farms are being turned from cotton and truck crops to forest products - pulpwood and some saw timber.

Principal communities in the area are Minden and Springhill, Louisiana, and Magnolia, Arkansas. In addition, there are some 16 other communities, which serve with the larger towns as trading centers for the basic agricultural economy.

The Bayou Dorcheat Basin is bounded by the Ouachita River Basin on the east and the Bodcau Bayou Basin on the west. The Ouachita River Basin is now well supplied with water, much of which is, or will be, controlled by multipurpose dams. Storage volume within one proposed reservoir project, DeGray Dam, would permit a 250 mgd discharge. A water district has been created to handle distribution of this water.[5/] Likewise, the Bodcau Bayou Basin has sufficient water available within its basin boundaries for future municipal and industrial demands. (For the purpose of this report, a full investigation of the Ouachita's and Bodcau's resources and potentialities did not seem warranted, since neither basin requires future augmentation of its water supply from outside sources.)

The economy of the area is undergoing a change and has not as yet crystallized so that it could be termed either concentrated or diversified. Three events have guided the development of the region. The first, early in local history, was the opening of Red River to navigation, which brought settlers. The second, occurring in the last century, was the coming of the railroad, supplanting the river as a means of commerce and opening the way to market for the region's timber. Lastly was the discovery of oil and gas in the region. The effect of this last event is still being felt as the region's economy advances.[4/]

Currently, the types of industry operating in the basin are involved in pulp and paper production, oil and gas production and refining, metal working (aluminum extrusions) along with related light industry and service establishments to meet local demands.

ECONOMICS AND POPULATION

Municipal and industrial water demands will be centered at the principal cities in the area. Cities of major importance in the basin are Minden and Springhill, Webster Parish, Louisiana, and Magnolia, Columbia County, Arkansas. Expansion of the population, industrial growth, and an accompanying increase in water requirements depend to a great extent upon the presence of the natural resources and their development.

The growth pattern can best be anticipated by analyzing the basin's economic environment. Present economic patterns and past growth trends are used to provide indications of future growth trends.

Extractive Industries

Minerals

The extraction of mineral resources plays an important role in the economy in the Bayou Dorcheat Basin. The total value of mineral extraction in the study area has ranged from $94,000,000 to $112,000,000 annually from 1954 through 1958. See Table 2.

Table 2[6/]

Value of Mineral Production--1954-1958
Webster and Claiborne Parishes, Louisiana
Columbia, Lafayette, and Nevada Counties, Arkansas
(Figures in millions of dollars)

State	Parish or County	Year				
		1954	1955	1956	1957	1958
Louisiana	Webster	$ 25	$ 28	$ 30	$ 37	$ 33
Louisiana	Claiborne	26	26	26	27	27
Arkansas	Columbia	24	22	22	28	26
Arkansas	Lafayette	16	15	15	17	13
Arkansas	Nevada	3	3	3	3	2
	Total	$ 94	$ 94	$ 96	$112	$101

Production of crude petroleum in this region totaled 23,709,000 barrels in 1959. Estimated reserves in this area are 320,401,000 or sufficient to sustain the current production rate for about 13 years.[7/] The search for additional oil and gas continued during 1959. A total of 178 wells were drilled within the study area, of which 97 are producing crude oil; seven are producing natural gas; and the remainder

were dry holes.[7] At present, there are approximately 4,360 wells in the study area. Other mineral resources of the region being currently extracted include sand and gravel and fire clay.[6]

Forest Resources[4,8]

The five-county study area has increased its commercial forest area from 1,085,000 acres in 1934 to approximately 1,446,000 in 1958. Standing saw timber, principally pine and oak, in this area totals 1,353 million board feet. The timber production in that portion of the study area lying in Louisiana was 15,646,378 board feet in 1958 and 15,462,016 board feet in 1959.[9] Indications are that the growth rate is greater than the harvest.

Agriculture[10,11]

Agriculture's contribution to the growth of the economy within the study area is at a standstill, with the exception of livestock sales. The number of farms in the study area has steadily decreased from 1945 through 1954. The farms have decreased in number from 12,058 in 1945 to 8,600 in 1954. Coupled with this trend has been a significant decline in croplands harvested from 288,493 acres in 1945 to 157,172 acres in 1954. Although the value of crops sold advanced from 1944 to 1949, the decline from 1949 to 1954 carried it below the 1944 level. However, the value of livestock and livestock products sold has shown a marked increase partially offsetting the drop in value of crops sold. Table 3 illustrates this situation.

Table 3

Value of Crops and Livestock Sold
Claiborne and Webster Parishes, Louisiana
Columbia, Lafayette, and Nevada Counties, Arkansas

Year	Value of Crops Sold	Value of Livestock Sold	Total
1944	$5,374,066	$1,821,837	$ 7,195,903
1949	9,672,980	2,776,011	12,448,991
1954	4,845,703	3,723,581	8,574,284

Manufacturing[12]

The manufacturing base in the study area has undergone several changes in recent years. The number of employees grew from 6,464 in 1947 to 9,511 in 1954 and then dropped back to 5,840 in 1958. This dwindling in manufacturing activity also appears in the decrease in value added by manufacturing from $57,055,000 in 1954 to $54,334,000 in 1958. At least a part of this reduction in manufacturing employment and output can be attributed to the closing of the Louisiana Ordnance Works in Webster County.

There also has been a significant decrease in the total number of firms employing 20 or more. This decline is centered in the lumber and wood products industries. However, the decline in number of firms employing 20 or more was accompanied by a counter trend of an increase in the number of employed. There is a statistical paradox resulting from the ranges involved.

Table 4

Number of Firms by Size and Type of Manufacturing
Claiborne and Webster Parishes, Louisiana
Columbia, Lafayette, and Nevada Counties, Arkansas
1947 and 1954

Type of Manufacturing Firms	Number with 20 - 99 Employees		Number with 100 & over Employees		Total Number of Firms With Over 20 Employees	
	1947	1954	1947	1954	1947	1954
Food and kindred products	2	5	-	-	2	5
Textile mill products	-	-	1	1	1	1
Apparel and related products	1	1	-	1	1	2
Lumber and wood products	34	12	8	6	42	18
Furniture and fixtures	-	1	-	-	-	1
Pulp, paper, and products	-	1	3	3	3	4
Chemicals and products	1	1	-	-	1	1
Petroleum and coal products	1	1	1	-	2	1
Primary metal industry	-	1	-	-	-	1
Machinery, except electrical	1	-	-	-	1	-
Transportation equipment	-	2	-	-	-	2
Miscellaneous manufacture	-	-	-	1	-	1
	40	25	13	12	53	37

Retail Trade[13/]

Commercial development trends usually follow industrial developments. As with agriculture and manufacturing, there has been little expansion in the study area. Although there was an increase in sales volume from 1948 to 1954, the next three years (through 1958) brought very little increase. Likewise, there was not an appreciable change in the number of employees in the service industry category between 1948 and 1958. During this time, the number of establishments has actually decreased from 1,248 to 1,144. Table 5 shows this lack of expansion in the region.

Table 5

Retail Trade Developments
Claiborne and Webster Parishes, Louisiana
Columbia, Lafayette, and Nevada Counties, Arkansas

	1948	1954		1958	
Number of Establishments	1,248	1,141		1,144	
Number of Employees	2,572	2,799		2,736	
Sales Volume ($1,000's)	58,529	77,572	(69,467*)	77,064	(64,148*)

*Adjusted to 1948 value of the dollar.

Population[14/]

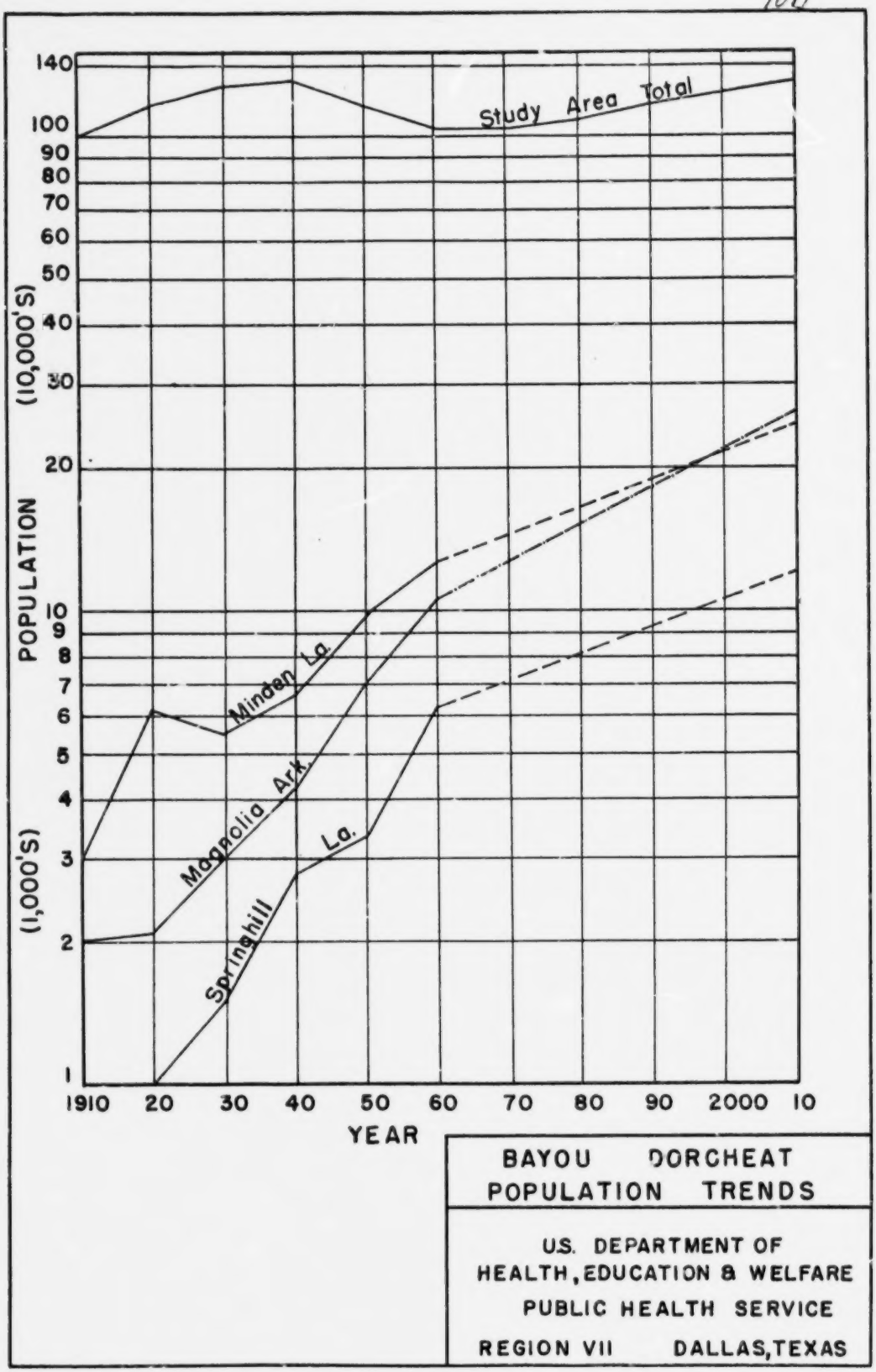
The population gradually built up in this region from 101,241 in 1910 to 130,073 in 1940 and has been decreasing ever since. (See Figure 2.) The 1960 census shows the combined population in the study area to be 106,785. While the total population has not increased significantly from 1910 to 1960 (and, in fact, decreased from 1940 to 1960), the number of persons living in communities has tripled. In 1910, only 15,887 resided in the towns and cities of the area; by 1950, the number had grown to 43,626.

Only Webster Parish registered a significant gain between 1950 and 1960. In all probability, the major portion of this gain is found in Springhill's increase from 3,383 in 1950 to 6,346 in 1960 and Minden's jump from 9,787 to 12,738 during the same period. Magnolia, Columbia County, has also expanded its population by approximately 200 per cent in the last 30 years. These three communities have experienced considerable growth even though the region's population is declining. This growth is illustrated in Table 6, together with the forecasted population for 2010.

Table 6

Population Trends and Forecast
1910 - 2010

	1910	1920	1930	1940	1950	1960	Forecast 2010
Minden, La.	3,002	6,105	5,623	6,677	9,787	12,738	24,500
Springhill, La.	---	748	1,546	2,822	3,383	6,346	12,000
Magnolia, Ark.	2,045	2,158	3,008	4,326	6,918	10,600	26,000



BAYOU DORCHEAT
POPULATION TRENDS

US. DEPARTMENT OF
HEALTH, EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

FIGURE 2

Future Growth

From 1960 to 2010, the Nation is expected to double in population, causing a large increase in demand for goods and services. Although the demand will be exerted by all parts of the country, the rate of increase in production will not be uniform in all areas. The more favorably endowed communities will have better opportunities for growth.

A considerable increase in demand for the petroleum, natural gas, and timber resources of the area can reasonably be expected. The estimated petroleum reserves will sustain the current production rate for some time. Likewise, natural gas extraction can be continued for a number of years. Furthermore, explorations continue, and the existing reserves will probably be augmented. Pulpwood and saw timber output can be stepped up without appreciably depleting the ever-growing forest products reserve. The increase in livestock production can be expected to continue and may shortly exceed in value the crop production which is decreasing.

Another resource in this area, now receiving some attention, is low-grade iron ore. While current interest is for the most part speculative, there exists a possibility for development of a local industry with the resource.

A moderate amount of growth can be expected in the manufacturing base in this area. However, the Bayou Dorcheat Basin is located between two areas having relatively cheap water transportation -- the Ouachita River Valley to the east and the Red River Valley to the west. The current trend in the petroleum and petrochemical industries is toward large processing centers near markets or near points that offer cheap transportation to markets. Baton Rouge and Lake Charles, Louisiana, are processing centers drawing from this area. There are two small petrochemical plants in the Magnolia area, and this area may develop along these lines.

There is now a large pulp and paper operation in this general region. A large plant (employing 2,400) is located at Springhill and is the primary base for that town's livelihood although there is other manufacturing in the Springhill area. Another large pulp mill is located at Camden, Arkansas, approximately 40 miles northeast of Magnolia. It seems reasonable that a moderate sized pulp and paper operation could be successful in the Minden, Louisiana, area at some future date.

Reasonably good transportation facilities are available for the output of light industry. All three cities are served by railroad and highway systems.

Although not directly connected with industrial development, there are indications that Minden may be tending to become a "commuter" community for the Shreveport-Bossier City area. This could lead to some additional growth unsupported by a local industrial base.

It is expected that retail and service establishments will expand in number and employment to keep pace with the increased population in the communities.

WATER REQUIREMENTS

The municipal, and most of the industrial, water needs of the study area are currently being met from a ground-water source of supply, the Sparta sand, which underlies the area. Present use and forecast requirements are shown in Table 7.

Table 7

Municipal and Industrial Water Requirements
1960-2010

	1960 Average mgd	2010 Average mgd
Minden, La. Area		
Municipal	1.0	3.00
Industrial	negligible	3.00
Total	1.0	6.00
Springhill, La. Area		
Municipal	0.5	1.50
Industrial	30.0	35.00
Total	30.5	36.50
Magnolia, Ark. Area		
Municipal	0.8	3.25
Industrial	1.9	3.25
Total	2.7	6.50

Springhill, Louisiana

The largest water user in the study area is a pulp and paper mill located at Springhill. Until quite recently, this plant obtained its water from wells drilled to the Sparta sand. Records indicate that these wells yield from 900 to 1,300 gpm (1.3 to 1.9 mgd) each. [15] This paper mill now obtains its water supply from Lake Erling, an impoundment on Bodcau Bayou just north of the Arkansas-Louisiana state line. [16] All of the mill's water requirements, some 20,000 gpm (30 mgd), are met from this source of supply. [17] The city of Springhill obtains its water supply from the Sparta sand, having six wells with a total capacity of 2,125 gpm (slightly more than 3 mgd).

The wastes from the paper mill after treatment are discharged to Bodcau Bayou, while Springhill's municipal wastes are treated in an activated sludge type plant and released to Bayou Dorcheat. [19]

Minden, Louisiana

Minden, Louisiana, is served by five wells of the gravel-wall type. All are approximately 300 feet deep. The capacities of the wells, with pumping units presently installed, are shown in Table 8.

Table 8

Well Capacities - Water Works System
Minden, Louisiana

Well No.	Capacity of Pump		Rated Head
	gpm	mgd	(feet)
1	800	1.1	200
3	500	0.7	170
4	1,000	1.4	156
5	1,000	1.4	165
6	1,000	1.4	220

The wells have sufficient capacity to meet anticipated demands for several more years. However, the spacing of the wells is quite close, with a radius of 200 feet encompassing all five wells. As the demand for water increases and the pumping rate from this field is greater, the cones of influence of the individual wells will interfere with each other, resulting in a greater drawdown of the water table over the entire area. The time will come, however, when additional wells will be required and the new wells should not be located in close proximity to the existing field. [18] In view of this, the city should authorize a ground water investigation to determine where additional wells can be located sufficiently far from the existing well field to eliminate interference. Indications are that the Sparta sand has considerable additional capacity in the vicinity of Minden.

There are no large water-using industries in the Minden area at present.

Minden's wastes are discharged to Bayou Dorcheat after treatment in a high rate trickling filter type sewage plant, having capacity to process the flow from a population of 15,000. [19]

Magnolia, Arkansas

Like Springhill and Minden, Magnolia, Arkansas, obtains its water from wells drilled in the Sparta sand. The municipal water system is served by five wells, all located within the city. [20] Pertinent data relating to these wells are shown in Table 9.

Table 9

Well Capacities - Water Works System
Magnolia, Arkansas

Well No.	Equipped gpm	Equipped mgd	Depth	Location
3	*350	0.5	413 ft.	Vicinity of Main Pumping Station
5	900	1.3	473 ft.	
New Well	700	1.0	---	On North Street
4	525	0.75	434 ft.	Near No. 2 High Service Pump Station
6	*280	0.40	413 ft.	Green & Dudley Streets

*Output for short periods - interference from adjacent well.

Although Magnolia's present average pumpage is about 0.8 mgd, the total draw on the Sparta sand in this vicinity is about 2.7 mgd. This approximate 1.9 mgd over and above municipal demand pumped from the Sparta sand is used mainly by petroleum producers in the area for repressuring operations -- putting water under pressure in the oil-bearing sands to make possible additional petroleum extraction. The state authories in Arkansas are attempting to stop this practice. The repressuring would be accomplished using brine already available in the affected area, instead of fresh water.

"At the present time, it appears that the permanent safe yield of municipal wells within the area of the city is something less than the present average pumpage of 800,000 gallons per day. . . There are some indications from existing wells east of Magnolia that additional well capacity for the city can be developed within reasonable distance. Since the quality of well water in the vicinity is quite good, requiring minimum treatment, water obtained from wells is cheaper than that obtained from a surface supply," according to the city's consulting engineers. The consultants further recommend that the city

should initiate a full study of future well water supply to determine the amount of the water economically available. The "new well" previously mentioned, yielding less than 700 gpm was the result of some exploration on the part of the city to develop additional capacity within the city limits.

In other areas the Sparta sand yields considerable quantities of good quality water. The available information shows that at Magnolia the present rate of pumping (total - 3.0 mgd more or less) does not exceed the maximum rate that can be maintained over a long period of time. However, any large increase could not be met in this vicinity. 21/

Magnolia is served by two sewage treatment plants. Both are of the primary type and discharge to Big Creek, a tributary of Bayou Dorcheat. Several small industries are located in the Magnolia area - two aluminum extrusion firms and two natural gas processing plants. These release their wastes to Bayou Dorcheat via its tributaries.

Secondary treatment for all wastes discharged to this stretch of the Dorcheat Basin is desirable. Magnolia's consulting engineers have prepared a report covering secondary treatment for the city.

Quality Considerations

In the Bayou Dorcheat Basin, pollutants, save for oil field brines, create, in general, localized areas of gross pollution without affecting lengthy reaches of the stream or its tributaries. 22/ Table 10 presents an indication of the existing water quality in the upper reaches of the stream.

The Arkansas Water Pollution Control Commission in General Order No. 1-59 set up a plan to abate oil field brine pollution in stages. Total abatement will be effected not later than June 30, 1964. 23/ All crude oil producing operations will be required to reinject their salt brine or dispose of it so that there will be no discharge to any watercourse. This will materially reduce chloride concentrations in Arkansas, particularly in the Bayou Dorcheat Basin. Louisiana is expected to pursue a similar program.

The Arkansas brine cleanup program should improve the quality of Bayou Dorcheat at site 20 so that the chloride content will be consistently within the U. S. Public Health Service recommended standard of no more than 250 ppm. This program coupled with Louisiana's proposed brine cleanup will improve the quality of Dorcheat Bayou at the Minden, Louisiana, gaging station with respect to oil field brine pollution.

Table 10

Results of Survey by the Arkansas Water Pollution Control Board

Sampling Point	Date	Temp. (°F) Air	Temp. (°F) Water	pH	Tot. Alk.	Tot. Hard.	SO_4	Ca	Fe	Mn	Cl	D.O.	BOD	Turb.	*Flow (cfs)
Bayou Dorcheat at proposed site 20 (just north of Ark. Rt. 132)	Sep.'58	79	79	5.0	3	275	21	68.8	0.31	25.8	813	6.6	1.5	--	6.65
Big Creek (tributary to Bayou Dorcheat)-upstream from Magnolia, Ark. (at U. S. 82 northwest of Magnolia)	Jul-Sep 1958	86	76	6.3	9	138	--	28.8	----	----	6	5.2	---	31	7.01
Big Creek upstream from Big Creek sewage treatment plant, but downstream from Texas Metals (at Ark. Rt. 132)	July-Oct 1958	92	73	7.2	25	50	--	4.0	----	----	11	3.6	10.7	40	7.14
Big Creek-downstream from Big Creek sewage plant, but about 6 miles upstream from proposed site 14	July-Oct 1958	83	74	7.2	54	26	--	5.9	----	----	19	1.5	6.7	29	8.4
Nations Creek (tributary to Big Creek)-below south sewage treatment plant and one mile above mouth (about 6 stream miles above proposed site 14)	July-Sep 1958	90	81	6.7	8	41	--	6.5	----	----	15	5.0	1.3	26	6.38

*Average for sampling period only.

Site 14

Site 14 is located downstream from the sewage and industrial wastes discharges of the Magnolia, Arkansas area. Locating an impoundment at this point will alter the waste assimilating capacity of Big Creek. Reservoirs and slack water have lower recovery ability than shallow moving streams. As Magnolia grows, so will its waste load to the stream. Assuming complete treatment (90 per cent removal of B.O.D.) for all wastes released, it is probable that the quality of water stored in an impoundment at site 14 will be degraded during periods of low stream flows. This, of course, is based on increased municipal and industrial waste loading and the existing minimum flow condition of 0.0 cfs at Magnolia.

The presence of considerable quantities of treated wastes in the flow entering the proposed impoundment at site 14 on Big Creek causes water storage at this site to be undesirable for municipal and industrial purposes.

Site 20

As shown in Table 10, existing oil field brine discharges upstream from proposed site 20 preclude its applicability for municipal and industrial water supply storage for the present. These releases impair the water quality by adding chlorides and hardness. The Arkansas brine cleanup will eliminate this source of pollution. With this accomplished, the water should be of satisfactory quality for municipal and industrial use following conventional treatment.

PRESENT SOURCES

The Sparta sand, which furnishes all of the municipal and a good part of the industrial water required in the study area, is moderately mineralized and quite free from hardness. 18,20,24/

Indications are that the municipal and industrial water requirements projected to the year 2010 for Minden and Springhill, Louisiana, can be met from the existing source of supply, the Sparta sand, which underlies the area. The large water user, a pulp and paper mill, in Springhill, has provided a surface water impoundment on Bodcau Bayou to meet its present and future needs. This releases capacity in the Sparta sand previously used by this mill.

Need for Additional Water

Contrasted with the ample ground water situation in the two major communities in Louisiana is the future prospect of critical ground water supply conditions in the Magnolia, Arkansas, section of the study area. Here, the projected average need is expected to reach 6.50 mgd in 2010 (Table 7) while the anticipated ground water yield is placed at approximately three (3.0) mgd. The additional water needs can be met from surface water available in the area. However, because the Sparta sand yields water of such good quality that little treatment is required besides chlorination, explorations for producing wells in this aquifer should be continued until it is certain that additional capacity is not available.

Plan for Supplying Additional Water

The Magnolia area is expected to continue using the Sparta sand as a source of supply for some time. When it will no longer meet the area's needs, water can be obtained from a single-purpose impoundment on Big Creek upstream from Magnolia, just west of McNeil.

Storage of Bayou Dorcheat water at site 20 also could be considered as a source of additional water supply for the Magnolia area. Site 14, because it receives a considerable quantity of municipal and industrial wastes, would not provide water of quality equal to that available at either site 20 (after chlorides are reduced to a reasonable level) or Magnolia's proposed single-purpose reservoir.

BENEFITS OF STORAGE AT SITE 20

The alternative cost method, employed for this project, is essentially based on the question, "What will be provided to meet the water requirements of the area in the absence of the project under consideration? And--how would the cost of this alternative compare to the project cost?" In the situation at hand, the alternative to transmitting water from site 20 to Magnolia is the construction of a single-purpose reservoir on Big Creek upstream from Magnolia.

Only alternatives for the Magnolia area are under consideration since it appears that the water requirements in all other parts of the study area can be met by ground water supplied from the Sparta sand. It may be that ground water will be able to meet the future needs in the Magnolia area and the use of surface water will not be required. Storage at site 20 would provide no benefit if enough ground water of suitable quality were available at reasonable cost to meet requirements throughout the area.

Assuming that the projected water requirements for the Magnolia area will outstrip the capabilities of the ground water source of supply at some future date short of the year 2010, the expected difference between known supply and projected demand will total about 3.5 mgd.

Site 20 is located approximately 10 miles from Magnolia. A raw water pump station and transmission line are required to provide water from storage at this site for use in the Magnolia area.

The alternative to site 20 is a single-purpose reservoir on Big Creek as proposed by Magnolia's consulting engineers.

Comparison of the costs of obtaining water from storage at site 20 or the most feasible alternative, a single-purpose dam on Big Creek, are based on financing the improvements over 50 years at 3% interest and 1.2¢ per kilowatt hour (kwh) energy cost. Local conditions may vary from these assumptions. Details of the items considered in arriving at the benefits for this project are appended to this report for use in adjusting costs to local situations when necessary. Fifty years is the economic life of the project adopted by the Corps of Engineers for analysis of average annual benefits. The interest rate is at or near that which prevails for financing over this period of time. Although this period and interest rate are not now available to municipalities, these conditions were chosen to meet the needs of this analysis. The energy cost (for transmission) is one considered for this type of operation.

Considering first the alternative, the cost of providing storage in the city's proposed single-purpose reservoir on Big Creek is 2.6¢ per 1,000 gallons. The cost of transmitting 3.5 mgd from this source to Magnolia would be 0.6¢ per 1,000 gallons. Thus, the total cost of obtaining water from the alternative would be 3.2¢ per 1,000 gallons.

Water from either Bayou Dorcheat or Big Creek will require the same treatment, more or less, prior to municipal and industrial use; therefore, treatment costs need not be considered in evaluating proposed site 20 or the city's Big Creek single-purpose reservoir.

The transmission costs from site 20 to Magnolia are 3.2¢ per 1,000 gallons. Therefore, storage of water for municipal and industrial purposes at site 20 will have no value for the Magnolia area since the transmission cost from storage in site 20 is, by itself, equal to the cost of both impoundment and transmission of water from the city's alternative (on Big Creek). Any charge for storage at site 20 when added to the transmission cost would cause the costs for this site to exceed those for the use of the alternative.

APPENDIX

EXHIBIT A-1

Basic Data Used in Calculations

Alternative for Magnolia, Arkansas

Cost of 31' Single-Purpose Dam on Big Creek	$506,000
Continencies -- 5%	25,300
Contract Price	531,300
Engineering and Miscellaneous -- 10%	53,130
Subtotal	$584,430
Land for Reservoir Site	249,000
TOTAL COST	$833,430

Annual cost @ 3% interest for 50 years
$833,430 (0.0389) = $32,400

$32,400/5.5 (365) (1,000) =
2.6¢/1,000 gallons Impoundment

Cost of Transmission

8,500 ft. 18" pipe @ $9.00/ft. =	$ 76,500
Pump Station	18,000
Total	$ 94,500
Contingencies -- 5%	4,725
Subtotal	$ 99,225
Engineering & Miscellaneous -- 10%	9,923
TOTAL COST	$109,148

EXHIBIT A-2

Annual Cost @ 3% interest for 50 years
$109,148 (0.0389) = $4,240
3,580
Annual Power Cost $7,820

$7,820/3.5 (365) (1,000) = 0.6¢/1,000 Transmission

Impoundment - 2.6¢/1,000 gallons
Transmission - 0.6¢/1,000 gallons

TOTAL COST 3.2¢/1,000 gallons

EXHIBIT A-3

Transmission from Site 20 to Treatment Plant Site

Item:	
52,800' (10 miles) of 18" concrete pipe @ $9.00/ft.	$465,000
Pump Station (Static head 77')	18,000
	$483,000
Contingencies -- 5%	24,150
Contract Price	$507,150
Engineering & Miscellaneous -- 10%	50,715
	$557,865
R/W-52,800' @ $2.00/ft.	105,600
Total Cost of Facilities for Pumping 3.5 mgd	$663,465
Annual Cost @ 3% interest for 50 years $663,465 (0.0389)	$ 25,800
Annual Power Cost -- Site 20 to Treatment Plant @ 1.2¢/kwh	14,000
TOTAL ANNUAL COST	$ 39,800

$39,800/3.5 (365) (1,000) = 3.2¢/1,000 gallons

Note: Cost of operation and maintenance of Magnolia's Big Creek Dam assumed to be equal to operation and maintenance costs for Site 20.

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